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Mineral composition of meconium

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MECONIUM obtained from newborn infants within 10 hours of birth was subjected to spectrochemical analysis for sodium, potassium, calcium, magnesium, iron, copper, zinc, manganese and to colorimetric determination of phosphorous.

These elements were quantitated in meconium from the following subjects: (1) sixty-five full-term apparently healthy infants, (2) eight infants who were later diagnosed as having cystic fibrosis (CF), (3) four infants with meconium ileus² requiring operation who were found to have cystic fibrosis, (4) one infant with intestinal obstruction requiring operation who was later found not to have cystic fibrosis, and (5) nineteen well siblings born into families known to have at least one child with cystic fibrosis.

From the Division of Clinical Laboratories and Research and the Department of Medicine, Children's Hospital Medical Center, the Department of Pediatrics, Harvard Medical School, and the Children's Cancer Research Foundation.

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The meconium was collected in hermetically sealed, acid-washed plastic containers and kept frozen until ready for analysis. The wet weight was determined and the meconium was desiccated in a vacuum oven at a pressure of less than 1 mm. Hg and temperature of 95° C. for 24 hours. The dry weight was determined and the specimens were washed in nitric and perchloric acids (5:1 V/V) until only a few drops of clear liquid remained.³

The mean values of some elements show considerable difference among the various groups studied. The concentrations of sodium, potassium, and magnesium were about twice as high in the meconium from the control subjects and well siblings than in the meconium from the patients with CF.

The "essential metals," or those known to be closely associated with enzymatic catalysis, were in higher concentrations in the healthy control subjects and in the well siblings of the CF patients; the concentration of manganese was twice as high, zinc and iron, about one and a half times as high, and copper, approximately 25 per cent higher.

The one infant with intestinal obstruction not due to meconium ileus showed a varied

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Table I. Electrolyte composition of meconium

Group	Mean and range in millimoles per kilogram of dry weight				
	Sodium	Potassium	Calcium	Magnesium	Phosphorous (inorganic)
(1) 65 Controls	328 (86-640)	93 (11-230)	47 (7-174)	84 (21-212)	20 (15-32)
(2) 8 Patients with CF	155 (63-230)	67 (40-110)	36 (19-59)	63 (35-152)	21 (13-34)
(3) 4 Patients with meconium ileus	254 (163-336)	33 (16-47)	72 (20-204)	37 (16-72)	36 (11-57)
(4) One infant with intestinal obstruction (but not CF)	600	35	47	41	—
(5) 19 Well siblings of patients with CF	328 (82-590)	98 (19-215)	44 (13-131)	96 (24-182)	29 (13-67)

Table II. Metals in meconium

Group	Mean and range in micrograms per gram dry weight			
	Copper	Zinc	Iron	Manganese
(1) 65 Controls	64 (22-152)	230 (39-369)	74 (28-172)	20 (5-53)
(2) 8 Patients with CF	30 (18-128)	157 (42-420)	53 (32-98)	10 (2-21)
(3) 4 Patients with meconium ileus	36 (21-61)	138 (36-284)	66 (45-88)	11 (5-20)
(4) One patient with intestinal obstruction (but not CF)	31	44	67	3
(5) 19 Well siblings of patients with CF	65 (27-122)	277 (18-600)	87 (26-168)	18 (5-41)

pattern of mineral concentration ranging in value from that characteristic of the control subjects (sodium 600 mM. per kilogram) to that which resembled the patients with cystic fibrosis, i.e., low zinc and manganese concentration.

The meconium obtained from patients with cystic fibrosis, from the asymptomatic siblings, and from patients with meconium ileus were also analyzed for the presence of proteins and occult blood, and with only 2 exceptions, the findings were consistent with the diagnosis.⁴

The wet to dry weight ratios were determined in all the control subjects and were found to average 4.3. The same ratio in the meconium taken from the resected ileus of 4 patients with cystic fibrosis averaged 2.2. The one patient with the intestinal obstruc-

tion (but not CF) had a wet to dry weight ratio of 2.6.

The results are tabulated in Tables I and II. Meconium normally contains high concentrations of inorganic elements. The assay of these elements for the purpose of diagnosing cystic fibrosis is not practical owing to overlapping values and a wide range of distribution.

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